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DRAWINGS ATTACHED

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(54) IMPROVEMENTS RELATING TO MOTOR DRIVEN CENTRIFUGAL PUMPS

(71) We, STANDARD MAGNET, AG a Swiss company of Hünenberg, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to motor driven centrifugal pumps having magnetic transmission couplings.

Pumps with a magnetic transmission coupling have the advantage that the pump housings are hermetically sealed by means of a magnetically pervious separating wall. They have the further advantage that they prevent a predetermined torque being exceeded, e.g. when conveying liquids of excessive viscosity or in the case of ingress of clogging solid bodies, by the use of permanent or hysteresis magnets for one of the pole rings of the coupling and a permanent magnet for the other pole ring of the coupling, in that the coupling drops out of synchronism and thereafter no longer transmits any significant torque.

According to the invention, in a motor driven centrifugal pump having a magnetic transmission coupling, the pump impeller forms with a soft magnetic first pole ring a unit enclosed in a pump housing and a shell of magnetically pervious material, a permanent magnet second pole ring drivable by the motor to transmit the motor torque to the said first pole ring and is arranged adjacent at the other side of said shell from the first pole ring, and means are provided for varying the amount of flux passing through the separating shell, whereby the transmitted torque is varied.

The soft magnetic pole ring preferably has a squirrel cage winding or a layer of material of high electric conductivity.

The means whereby the magnetic flux which determines the torque and which flows through the two pole rings can be varied include:

(a) increasing the air gap between the pole rings;

(b) producing or increasing an eddy current in the separating wall;

(c) partially short-circuiting adjacent poles by means of soft iron or permanent magnets; or

(d) increasing the magnetic reluctance in the return path region between the adjacent poles.

Alternative embodiments provide adjustability, respectively during operation and during standstill of the pump. Adjustability of the torque whilst in operation entails much more equipment, but is required only on very rare occasions.

Various forms of pumps embodying the invention will now be described by way of example with reference to the accompanying, partly diagrammatic, drawings, in which:

Figure 1 shows, partially in section, a circulating pump having a motor shaft which is axially adjustable during operation;

Figure 2 is a fragmentary view showing a pole ring axially slidable on the shaft during stand-still only, by means of a cam;

Figure 3 shows a housing construction with inclined slotted guides for axial displacement of the entire drive assembly relative to the pump housing; and

Figure 4 shows a housing construction with axial displacement of the driving assembly by means of a screw;

Figure 1 shows a centrifugal pump in accordance with the invention, partly in section. An impeller 2, which forms a unit with a soft iron pole ring 3, rotates in a pump housing 1. The pole ring 3 has a soft iron core which is enclosed by a copper shell 4, which serves simultaneously the purpose of producing eddy currents and of providing protection for the soft iron pole ring against corrosion. A motor housing 6 is secured to the pump housing 1 via a moulded rubber ring 5 which provides a positive connection and a measure of sound proofing.

The motor housing 6 contains an electric motor whose armature 9 is supported by end plates 7 and 8. The end plates are provided with ribs 10 which positively locate the motor centrally in the motor housing 6.

A concave pole ring 12 is built up of permanent magnet segments and is driven by the armature 9 via a shaft 13. A ball bearing 14 is slidably arranged in a bushing 15 of the end of plate 8 and is biased towards the armature 9 by a coiled spring 16. By means of a distance ring 17 the inner race of the ball bearing 14 is positively held on the shaft 13. A ball bearing 18 is supported in a bushing 19 of the end plate 7 by its outer race so as to be slidably displaceable. The outer race is positively secured to a screw 21 by a cup shaped intermediate member 20 by means of securing means 22. The screw 21 has a collar 23 which can be fixed axially by inserting annular shims 24. In the position shown the air gap between a separating shell 25 of magnetically pervious material and the concave pole ring 12 is at its narrowest. If the screw 21 is turned outwards, the spring 16 causes displacement of the armature-pole ring unit 9, 12 whereby the air gap between the shell 25 and the pole ring 12 is increased. The greater the air gap is made, the greater becomes the slip. It has been found that at the largest air gap at which the impeller 2 still rotates in a stable manner, the speed of the pole ring-impeller unit 2, 3 drops to approximately ⅓ of the nominal speed, whereby the hydraulic power of the pump is reduced to 1/27 whilst the power required of the motor is reduced 1/9. In this way a significant saving in electricity costs is achieved. The motor is cooled by means of a fan ring 26, which is attached to a soft iron yoke cap 27 of the pole ring 12 and is spaced at 28 from the motor housing 6. Cooling air enters at 29 and is discharged through the punched apertures 30.

The armature 9 is so associated with the motor housing 6, i.e. the stator that it lies flush within the stator when the collar 23 abuts the screw 21. As the coupling is reduced, the armature 9 is displaced slightly out of its stator.

Figure 2 shows a different construction, in which the distance of the outer pole ring 12, from the separating shell 25, is variable via a hub 33 which is slidably displaced in an axial direction on, and securable to, the motor shaft 34. Adjustment in the axial direction is accomplished by a cam 35 which slides in an elongated hole 36. The pole ring is secured by means of set screws 37. By contrast with the embodiment shown in Figure 1, this coupling can only be adjusted during standstill.

Figure 3 shows a further embodiment of the invention. A flange 37 in which the entire motor housing 38 is displaceable is secured to the pump housing 1. Axial adjustment is accomplished by angular displacement of the motor housing 38 as determined by slotted guides 39, which are at a set inclination, and fixing by tightening up screws 40. As in the case of the embodiment shown in Figure 1, the adjustment can, if desired, be made whilst the pump is running.

Figure 4 shows a further embodiment in which the motor 41 is suspended in two rubber rings 42 and 43 which are secured to the motor housing 44 in axially fixed relationship and exert an axial force in the direction of the arrow 45. The adjusting screw 46, which transmits its force via the elastic rubber element 47 to the motor 41 so as to prevent the transmission of sound from the body, acts against this axial force. As in the case of the embodiment shown in Figure 1, the adjustment can here also be made whilst the pump is running.

Our co-pending Patent Application No. 57073/70, Serial No. 1339539 describes a rotating electric machine having a stator and separating shell construction similar to that disclosed in the present specification and which includes an electrically non-conducting liquid in the housing for the stator, and condensating transfer means whereby a condensating of the liquid may be brought into thermal contact with the stator.

WHAT WE CLAIM IS: —

1. A motor driven centrifugal pump having a magnetic transmission coupling, wherein the pump impeller forms with a soft magnetic first pole ring a unit enclosed in a pump housing and shell of magnetically pervious material, a permanent magnet second pole ring is drivable by the motor to transmit the motor torque to the said first pole ring and is arranged adjacent and at the other side of said shell from the first pole ring, and means are provided for varying the amount of flux passing through the separating shell, whereby the transmitted torque is varied.

2. A centrifugal pump according to Claim 1, wherein a magnetic air gap of the coupling is variable by the means which effect axial displacement of one pole ring relative to the other.

3. A centrifugal pump according to Claim 2, wherein the said second pole ring is arranged so as to be displaceable by the means relative to its shaft and axially securable.

4. A centrifugal pump according to Claim 2, wherein the said second pole ring forms a unit with its shaft and the motor armature, this unit being arranged so as to be axially displaceable.

5. A centrifugal pump according to Claim 4, wherein the shaft is supported in ball bearings and the bearing nearest the pump

housing is spring biased towards the motor stator, whereas a second ball bearing is positively axially adjustable.

6. A centrifugal pump according to Claim 4, wherein the motor armature lies flush with its associated stator when the air gap between the said first and second pole rings is at a minimum, whereas the motor armature is displaced from this position as the air gap increases.

7. A centrifugal pump according to Claim 2, wherein the motor housing is arranged so as to be displaceable relative to the pump housing.

8. A centrifugal pump according to Claim 1, wherein the first pole ring which is unitary with the pump impeller consists of soft iron and carries a shell of a material of high electrical conductivity.

9. A centrifugal pump according to Claim 8, wherein said shell is copper and also protects the side of the rotor facing the separating wall.

10. A motor driven centrifugal pump according to Claim 1 constructed, arranged and adapted to operate substantially as hereinbefore described with reference to and as illustrated in any one or more Figures of the accompanying drawings.

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1339540 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1

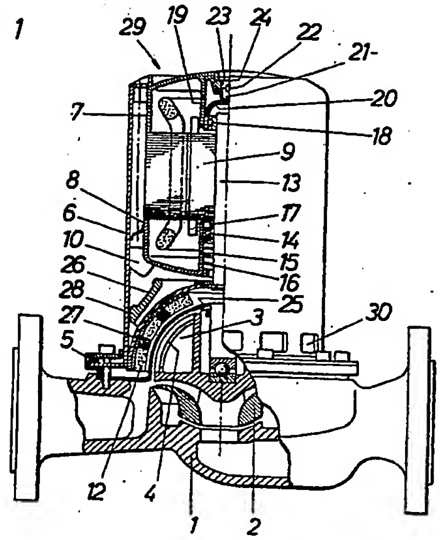

FIG. 2

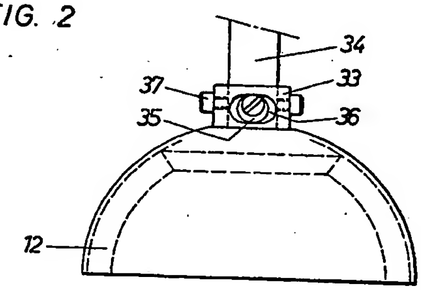

FIG. 4

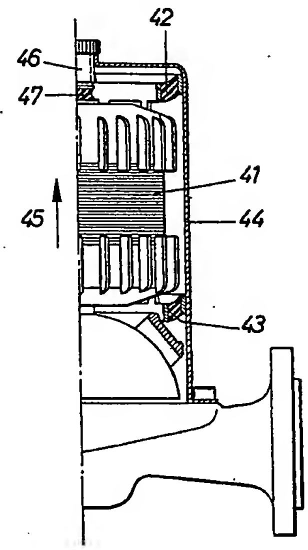

FIG. 3